Article

A longitudinal study describing horse demographics and movements during a competition season in Ontario, Canada

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Abstract — The objective of this study was to describe the demographics and movement patterns of a sample of horses in Ontario, Canada. A convenience sample of 222 owners completed an initial questionnaire to provide demographic information for 570 horses. These horses were enrolled in a longitudinal study to document their movements from May to November 2015 using a monthly questionnaire. The median age of the participating horses was 11 years (IQR: 8 to 16 years). The primary discipline of participating horses included competitive disciplines (63.3%), leisure (33.3%), and racing (3.2%). During the 7-month period, there were 3001 unidirectional movements of horses between facilities. Reasons for travel on/off a facility included attending a competition (38.7%), leisure activities (18.8%), and training (7.5%). The demographic and movement data presented in this study provide insight into the characteristics of a subset of horses in Ontario, and may contribute to outbreak preparedness in the population.

Résumé — Étude longitudinale décrivant les données démographiques des chevaux et leurs mouvements durant une saison compétitive en Ontario, au Canada. L'objectif de cette étude consistait à décrire les données démographiques et les mouvements d'un échantillon de chevaux en Ontario, au Canada. Un échantillon utile était composé de 222 propriétaires qui ont rempli un premier questionnaire afin de fournir des données démographiques pour 570 chevaux. Ces chevaux étaient inscrits dans une étude longitudinale afin de documenter leurs mouvements de mai à novembre 2015 à l'aide d'un questionnaire mensuel. L'âge médian des chevaux participants était de 11 ans (IQR : 8 à 16 ans). La discipline primaire des chevaux participants comprenait des disciplines de compétition (63,3 %), d'agrément (33,3 %) et de course (3,2 %). Durant la période de 7 mois, il y a eu 3001 déplacements unidirectionnels de chevaux entre les installations. Les raisons des déplacements à l'aller ou au départ d'une installation incluaient une compétition (38,7 %), des activités d'agrément (18,8 %) et l'entraînement (7,5 %). Les données sur la démographie et les mouvements dans cette étude ont fourni des renseignements sur les caractéristiques d'un sous-groupe de chevaux en Ontario et pourront contribuer à la préparation aux éclosions au sein de la population.

(Traduit par Isabelle Vallières)

Can Vet J 2018;59:783–790

Introduction

The effective prevention and control of equine disease outbreaks depend on accurate knowledge of the equine population at risk. Descriptions of baseline horse characteristics, such as vaccination histories, horse movement patterns, and the use of biosecurity measures by horse owners can lend support when planning disease prevention, surveillance, and control strategies (1,2). Populations of horses are highly diverse, ranging from horses that compete in sporting/competition events to those that are kept as companion animals. When horses visit locations outside of their home facility, there is a risk of exposure to infectious agents and possibly subsequent spread of infection (3–6). An understanding of horse demographics, and the extent of horse movements among facilities, would enable more thorough investigations into the potential for disease spread in the population.

Horse demographics and movement patterns have been previously described in numerous countries (7–11), sometimes based on existing data (2,12,13). When existing data are not available, interview and questionnaire-based methods have been used as alternative strategies to describe horse populations in Japan (14), Great Britain (9), New Zealand (8), and South Africa (15). Examples of major equine disease outbreaks in other countries, including equine influenza in Australia in 2007 (16) and equine herpes virus infections in the USA in 2011 (4), highlight the need to further describe the Canadian equine population to aid

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in the development of disease preparedness strategies before a major outbreak occurs.

There is limited information available describing the characteristics of the horse population in Ontario. Every 5 y, the Census of Agriculture, conducted by the Canadian government, provides updates on the number of horses and their geographical distribution throughout the country (17). The 2016 Census of Agriculture estimated that there were 64 536 horses residing on 9294 farms in Ontario (17). While this information provides a general overview of horses in Ontario, the demographics and movement patterns of the Ontario horse population have not been described in the literature. Having access to comprehensive information on horses and horse facilities in Ontario is important to inform evidence-based decisions on the utility of disease prevention and control strategies.

The objectives of this study were to i) describe the characteristics of a sample of horses and horse facilities in Ontario, Canada; and ii) describe the movements of these horses over a 7-month period (May to November 2015). This time period was chosen to capture horse movements during the summer and fall seasons, as we assumed that most equestrian activities would occur during this time given the continental climate in Ontario.

Materials and methods

Study design

This was a descriptive study consisting of 2 phases: an initial cross-sectional questionnaire ("Enrollment questionnaire," March to June 2015), and a longitudinal study ("Monthly questionnaire," May to November 2015). The cross-sectional questionnaire was used to describe the characteristics of the sample of horses and to enroll horse owners into the longitudinal study. The longitudinal study was used to collect information on horse movements from the participating owners on a monthly basis. This study was reviewed and approved by the University of Guelph Research Ethics Board (REB#15FE013).

Recruitment

Participant recruitment occurred between March 13th and June 8th, 2015. Due to the absence of an available registry of horses, owners, or facilities in Ontario, a sampling frame could not be established for recruitment and/or sample size calculation. A variety of electronic, print, and in-person methods were used for recruitment, including social media advertisements and distribution through the mailing lists of relevant equestrian organizations and industry groups. Individuals were eligible to participate in the study if they were 18 y of age or older, resided in Ontario, and were the person responsible for at least 1 horse. Individuals were invited to participate in the study regardless of the use of their horse and the owner's estimate of the frequency of travel (i.e., a participant was not required to travel with their horse to join the study). Individuals were required to have either an e-mail address or a telephone number to participate. Upon enrollment, participants were entered into a draw to win 1 of 3 gift cards from an equine equipment store, and received additional entries for each monthly response during the longitudinal study.

Questionnaire design and data collection

The initial enrollment questionnaire was a modified electronic version of a questionnaire previously tested in a pilot study by Spence et al (18). The questionnaire was administered using the survey software Qualtrics (Qualtrics, Provo, Utah, USA) and was beta-tested by a group of 7 individuals, including researchers, veterinarians, and horse owners. The enrollment questionnaire consisted of 14 questions regarding descriptions of the participant's horse(s) and the facility where their horse was boarded (referred to as the horse's "home facility"). Participants could enroll up to 10 horses if they were the person responsible for all of the enrolled horses. Descriptive horse characteristics that were collected using the questionnaire included: age (open-ended), gender (closed-ended), primary sport/competition discipline (closed-ended, further categorized into racing, leisure, or competitive disciplines for statistical testing), and vaccines administered in the past 12 mo (closed-ended). Descriptive characteristics of home facilities included: the first 3 digits of the postal code (open-ended), the number of other owners who also boarded horses at the facility (closed-ended), the total number of horses at the facility (open-ended), the horse's primary sport/competition discipline (closed-ended), and the presence of foals, mares used for breeding purposes, and/or senior horses (16 y or older) at the facility (closed-ended). Participants could only choose one primary sport/competition discipline for each horse that they enrolled, but they could choose up to 3 disciplines to describe the horses at their home facility. Each owner was assumed to come from a unique home facility unless otherwise indicated in their response (i.e., 1 owner response per home facility). A copy of the enrollment and monthy questionnaires can be obtained from the corresponding author upon request.

Participants who completed the enrollment questionnaire provided informed consent to join the longitudinal study, which was a monthly online questionnaire administered using Qualtrics. A link to the questionnaire was sent by e-mail on the afternoon of the last day of the month and included questions about the participating horses' movements during that month. For example, the first questionnaire was distributed on the afternoon of May 31st and included questions about horse movements during the month of May. Each questionnaire was unique to the participant so that their response could be identified.

Each monthly questionnaire followed the same design. At the beginning of the questionnaire, the participant was asked if their horse(s) had left the home facility for any duration of time within the month. If the participant responded "no," their monthly questionnaire entry was complete. If the participant responded "yes," they continued to answer additional questions regarding these movements. Participants could also report if they no longer owned their horse, which would result in the owner being removed from any additional monthly questionnaires. Participants whose horse(s) travelled during the month were asked to indicate the date(s) that their horse(s) left the home facility. For each chosen date, participants provided details on: i) the reason for travel (closed-ended); ii) the city/town of the destination (open-ended); iii) the name of the destination (e.g., facility name), if available (open-ended); and iv) whether it was an overnight trip (closed-ended). Participants chose the reason

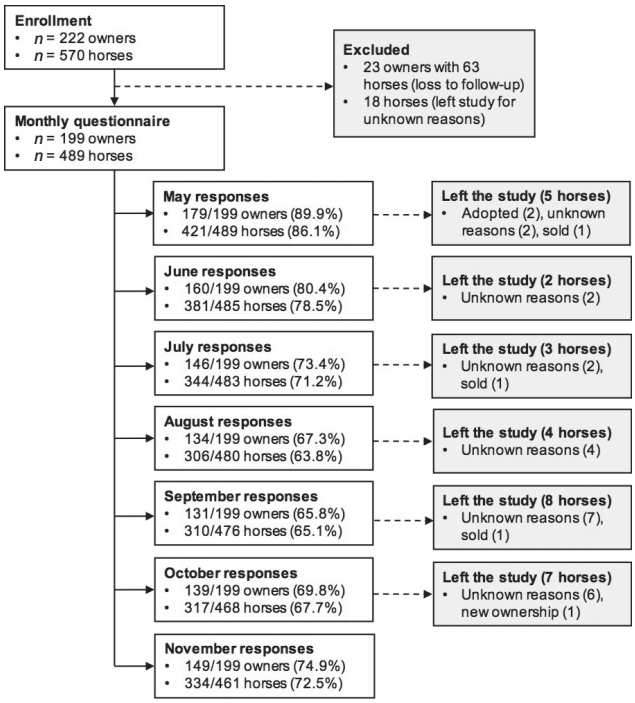

Figure 1. An overview of the longitudinal study design for horses in Ontario, Canada, including participation rates for each month between May and November 2015.

for travel from a drop-down menu, which included the options of: competition, veterinary clinic, off-site lesson, race track, farrier, breeding, sales barn, leisure ride, performance/training clinic, and "other, please specify." One monthly questionnaire was completed for each horse enrolled by the participant; however, the participant had the option to complete only 1 questionnaire if all of their horses had the exact same travel patterns during that month. Two weeks after the link to the questionnaire was sent, a reminder e-mail was sent to participants who had not completed the monthly questionnaire. Participants were sent monthly invitations regardless of their response (or non-response) to the previous month's questionnaire. The monthly questionnaires remained active until January 1st, 2016, and participants could follow their questionnaire link until this time if they had forgotten to complete a monthly questionnaire.

Descriptive and statistical analyses

All data were cleaned to remove any spelling errors that arose from participants' answers to open-ended questions, and were entered into a relational database in Microsoft Access 2016 (Microsoft Corporation, Redmond, Washington, USA). The descriptive analyses of horse and home facility characteristics used the denominator data from the responses to the initial enrollment questionnaire. Descriptions of horse movement patterns were dependent on the participation rate each month. A movement was defined as an event in which a horse was transported from one facility to a unique destination. Movements were described by their directionality to distinguish between temporary (return) movements, and permanent (one-way) movements. A bidirectional movement occurred when a horse returned to its original location after reaching its unique destination location (e.g., location A to location B to location A). The number of bidirectional movements presented throughout this manuscript is the sum of the outgoing movement from a facility (e.g., location A to location B) and the return movement back to the original facility (e.g., location B to location A). A unidirectional movement occurred when a horse did not return to its original location after reaching its unique destination (e.g., location A to location B). The total number of movements during the study period was calculated by adding the total sum of the bidirectional movements and the number of unidirectional movements.

Table 1. Distribution of reported primary sport/competition disciplines of horses enrolled in a longitudinal study in Ontario, Canada.

Discipline category	Discipline	Number (n = 570)	Percent (%)
Racing	Racing	18	3.2
Competition	Hunter/Jumper	113	19.8
	Dressage	46	8.1
	Eventing	42	7.4
	Western pleasure	27	4.7
	Driving	26	4.6
	Barrel racing/pole bending	28	4.9
	Breed-specific competitions	21	3.7
	Reining	13	2.3
	Halter/line classes	10	1.8
	Gymkhana	9	1.6
	Competitive trail riding	9	1.6
	Other[a]	17	3.0
Leisure	Pleasure riding	99	17.4
	Retired	42	7.4
	Non-competitive trail riding	36	6.3
	Other[b]	13	2.3
No response	—	1	0.2

[a] Participant responses include breeding, cutting, endurance, English and Western dressage, extreme cowboy, fox hunting, and roping.
[b] Participant responses include cattle sorting, English and Western pleasure, flat work, yearlings in training, and therapy work.

The statistical software packages Stata (Stata Statistical Software: Release 14; Stata Corp 2013, College Station, Texas, USA) and R (R Core Team. 2016. R: A Language and Environment for Statistical Computing; R Foundation for Statistical Computing, Vienna, Austria) were used for all descriptive analyses. Graphs were produced using the "ggplot2" package in R. Statistically significant differences ($P < 0.05$) between variables with categorical outcomes were assessed using the Fisher's exact test, and differences between variables with continuous outcomes were assessed using the Wilcoxon rank-sum test.

Results

Questionnaire response

A total of 222 participants completed the initial enrollment questionnaire and provided information on 570 horses (Figure 1). After completing the enrollment questionnaire, 23/222 (10.4%) of owners were lost to follow-up (i.e., did not respond to any questionnaire invitations for the duration of the longitudinal study). A median of 1 horse per participant was enrolled into the study. Owners who were lost to follow-up and owners who provided responses for the entire duration of the study both

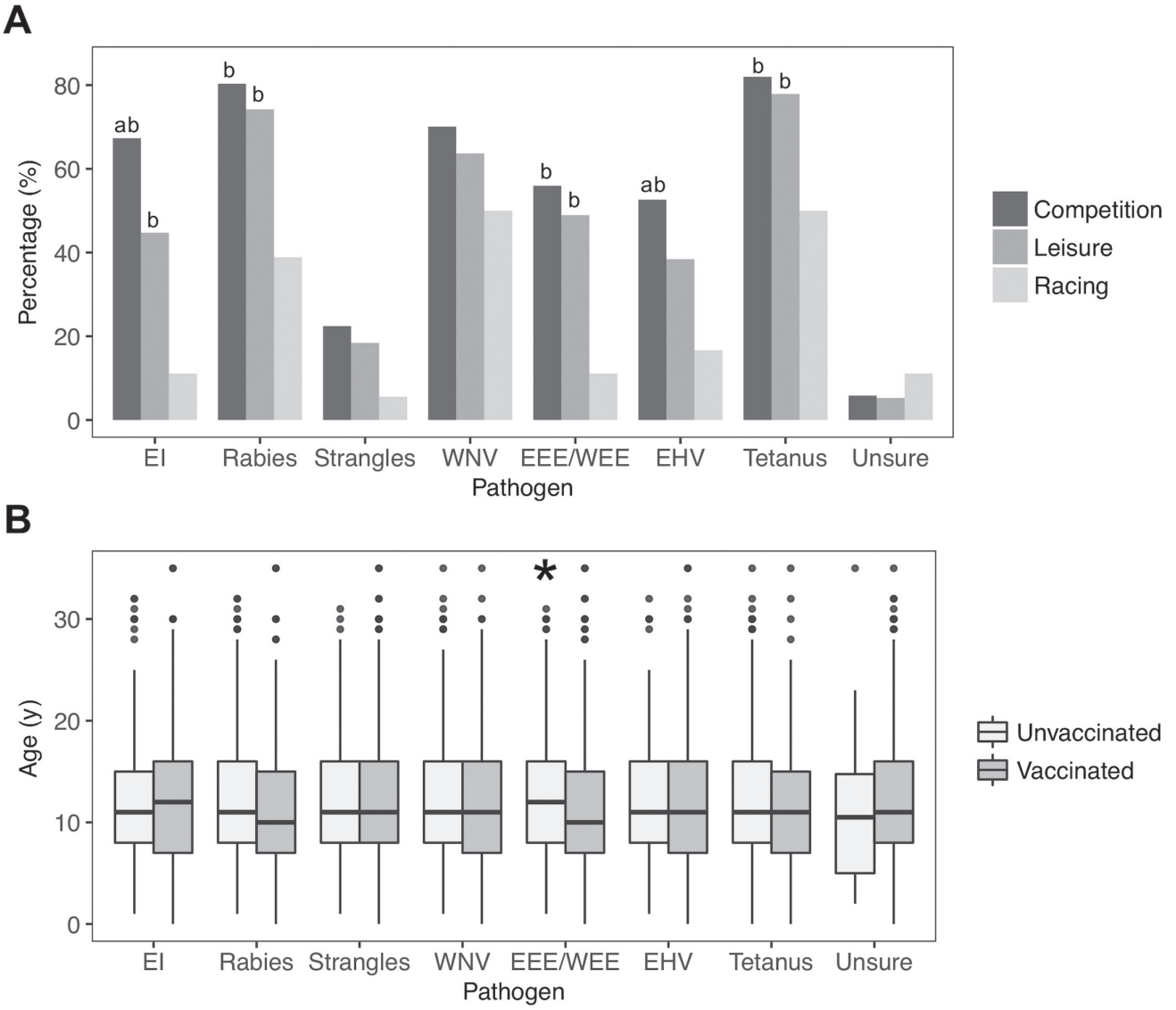

Figure 2. A – Proportion of horses vaccinated per primary sport/competition discipline category based on responses to the initial enrollment questionnaire ($n = 570$ horses, disciplines listed in Table 1). Letters indicate statistically significant differences ($P < 0.05$) of pairwise comparisons using the Fisher's exact test (a = leisure as referent, b = racing as referent). B – Age of vaccinated and unvaccinated horses for each pathogen. The bottom and top of each box represent the 25th and 75th percentiles, respectively, and the horizontal line within the box represents the median. The asterisk indicates statistically significant differences ($P < 0.05$) tested using the Wilcoxon rank-sum test. EI – equine influenza, WNV – West Nile virus; EEE/WEE – Eastern/Western equine encephalitis; EHV – equine herpesvirus.

enrolled a median of 1 horse per participant ($P = 0.94$). Owners who were lost to follow-up had a shorter elapsed time between their initial enrollment and the start of the longitudinal study [median = 59 d, interquartile range (IQR): 58 to 69 d] compared to owners who provided responses for the entire duration of the study (median = 64 d, IQR: 45 to 69 d) ($P = 0.39$). The 23 owners who were lost to follow-up and their corresponding 63 horses were excluded from the longitudinal study analysis. In addition, 18 horses were excluded from the longitudinal study as their owners identified they no longer owned these horses before the first monthly questionnaire. A final total of 199 owners and 489 horses were included in the longitudinal study analysis.

Participation rates for each month of the longitudinal study are presented in Figure 1. Forty-four percent (87/199) of participants provided responses for all 7 mo. Participants who responded for fewer than 7 mo were not considered lost to follow-up because responses could occur during select months of the study (e.g., they could respond 1 mo, miss the second month, and respond the third month). Most participants completed the monthly questionnaire within 2 d of receiving the invitation, as the median response time per month ranged between zero (i.e., completed the same day) and 2 d.

Six percent (29/489) of horses were withdrawn from the longitudinal study (Figure 1). Seventy-nine percent (23/29) of horses that were withdrawn from the longitudinal study left for unreported reasons (i.e., owner simply indicated that they no longer owned that horse). Horses that were withdrawn from the longitudinal study were of similar age (median = 10 y, IQR: 6 to

Table 2. The number of bidirectional and unidirectional horse movements between May and November 2015, based on owner-completed monthly questionnaires during a longitudinal study in Ontario, Canada.

Month	Number of horses that travelled	Movements			Number (%) of total movements per discipline		
		Bidirectional[a]	Unidirectional	Total	Competition	Leisure	Racing[b]
May	159	550	24	574	459 (80.0)	85 (14.8)	30 (5.2)
June	134	484	10	494	458 (92.7)	28 (5.7)	8 (1.6)
July	117	490	9	499	462 (92.6)	37 (7.4)	—
August	106	508	7	515	437 (84.9)	78 (15.1)	—
September	102	394	10	404	364 (90.1)	40 (9.9)	—
October	97	276	14	290	248 (85.5)	42 (14.5)	—
November	73	210	15	225	174 (77.3)	51 (22.7)	—

[a] Presented as the total sum of the outgoing movement from a facility and the return movement to the original facility.
[b] Dashes indicate missing data due to owner non-response.

Table 3. The number of horses that travelled each month, and the number of movements made per horse given that it travelled during the month, based on owner-completed monthly questionnaires during a longitudinal study in Ontario, Canada.

Month	Travelled		n[a]	Proportion travelled (%)	Median (IQR) number of movements per horse[b,c]
	Yes	No			
May	159	262	489	32.5	2 (2 to 4)
June	134	247	485	27.6	2 (2 to 6)
July	117	227	483	24.2	4 (2 to 6)
August	106	200	480	22.1	4 (2 to 6)
September	102	208	476	21.4	4 (2 to 4)
October	97	220	468	20.7	2 (2 to 4)
November	73	261	461	15.8	2 (2 to 2)

[a] The number of horses included in the study each month, after accounting for losses due to withdrawals.
[b] Given that the horse travelled at least once during the month.
[c] IQR — interquartile range.

15 y) and discipline (55% competition, 36% leisure, 9% racing) compared to horses that remained in the study [age: median = 11 y, IQR: 8 to 16 y) (P = 0.42); discipline: 61% competition, 33% leisure, 3% racing (P = 0.08)].

Horse demographics

The median age of the participating horses was 11 y (IQR: 8 to 16 y). Fifty-five percent (312/570) of horses were geldings, 42.8% (244/570) were mares, and 2.5% (14/570) were stallions. The top 2 primary sport/competition disciplines captured in this study were hunter/jumper (19.8%, 113/570) and pleasure riding (17.4%, 99/570) (Table 1). When categorized, 63.3% (361/570) of horses participated in a competitive discipline, 33.3% (190/570) of horses participated in leisure activities, and 3.2% (18/570) of horses participated in racing.

Within the 12 mo prior to the study, participating horses (n = 570) were vaccinated against equine influenza (57.9%), rabies (76.8%), *Streptococcus equi* (strangles) (20.5%), West Nile virus (67.2%), Eastern/Western equine encephalitis (52.1%), equine herpesvirus (46.7%), and tetanus (79.5%). Fourteen percent of the horses had not received any vaccinations in the past 12 mo. The proportion of horses vaccinated against each pathogen varied depending on the primary sport/competition discipline of the horse, but did not vary significantly by age, with the exception of vaccination against Eastern/Western equine encephalitis (Figure 2).

Home facility characteristics

The median number of horses boarded at a home facility was 15 (IQR: 5 to 25). Of the 222 participants 61% reported that 4 or more owners had horses at their home facility, 15.3% reported that 2 or 3 owners had horses at the facility, and 23.9% reported that they were the sole owner of all horses at the facility. Eighty-two percent of participants stated that there were senior horses (16 y of age or older) present at the home facility, 29.3% indicated the presence of mares used for breeding purposes, and 25.2% indicated the presence of foals.

Twenty-four percent of the 222 participants stated that the horses boarded at their home facility competed in the same primary sport/competition discipline (e.g., they all were dressage horses), while 76.1% of participants stated that the horses boarded at their home facility did not compete in the same discipline (e.g., some were dressage horses and some were hunter/jumper horses). Of the home facilities with a mixture of primary sport/competition disciplines, 16.6% (28/169) involved 2 disciplines, 59.8% (101/169) involved 3 disciplines, and 23.7% (40/169) were a mixture of 4 or more disciplines.

Horse movements

A total of 3001 horse movements occurred throughout the duration of the study (Table 2). The highest proportion of horse movements (574/3001) occurred in May, while the smallest proportion of horse movements (225/3001) occurred in November (Table 2). The proportion of horses that travelled per month ranged from 32.5% (159/489) in May to 15.8% (73/461) in November (Table 3). The median number of movements per horse, given that the horse travelled at least once during the month, peaked during the months of July, August, and September (Table 3). From May to September, most movements were to attend a competition (34.5 to 46.9% of movements each month) (Figure 3). In October, most movements were for leisure rides (31.7%, 92/290), and in November, most movements were to attend a lesson (31.1%, 70/225). Examples of "other" reasons for travel provided by participants included: letting their pasture grow, foxhunting, moving to a new home facility, community

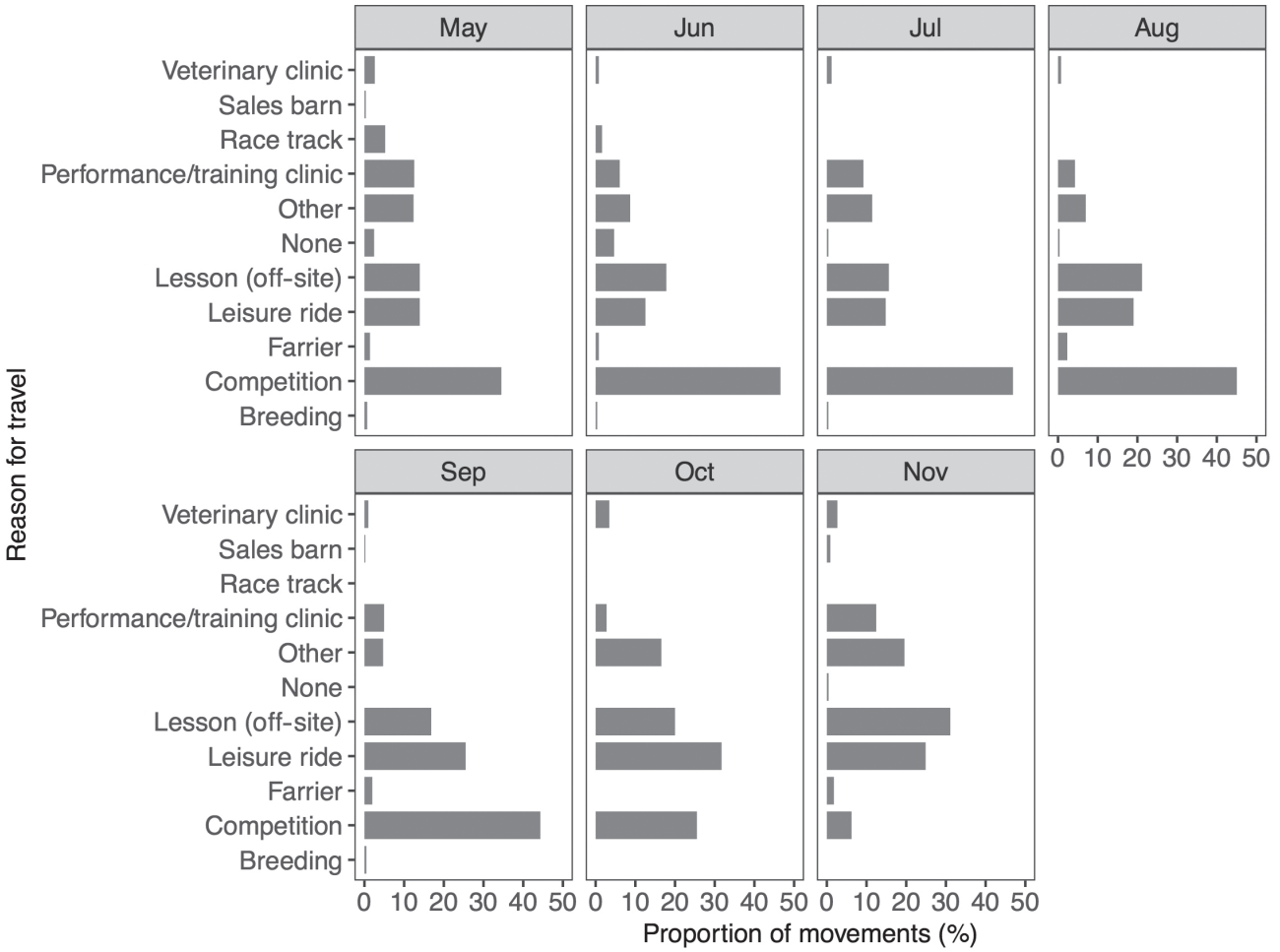

Figure 3. The reason for horse movements on/off the home facility per month, based on owner-completed questionnaires during a longitudinal study from May to November 2015 in Ontario, Canada ($n = 3001$ movements). The total number of movements per month is provided in Table 2.

events (e.g., horse drawn funerals, wagon rides, parades), house/horse sitting, visiting a friend, and cattle sorting.

Ninety-seven percent of the 3001 horse movements during the study period were bidirectional and 3% were unidirectional (Table 2). Fifty-seven percent (51/89) of unidirectional movements were permanent moves to new home facilities (i.e., the horse did not return to its original home facility). Most of these permanent movements occurred in May (33%, 17/51), October (22%, 11/51), or November (22%, 11/51). Throughout the study period, there were 5 horses that stopped at multiple locations between their first departure location and their final destination location. During a permanent move to a new home facility, 2 horses made one stop each, and 1 horse made 4 stops between their previous home facility and their new home facility. In another instance, 2 horses left their respective home facilities to attend a competition, but stayed overnight at a different venue before returning to the competition the following day.

While 98.3% of the 3001 movements over the 7-month period occurred locally within Ontario, 0.5% of movements were to locations outside of Ontario (but within Canada), and 1.2% were international movements to the United States. Of the movements to the United States, 94% (33/35) were to attend a competition, and 6% (2/35) were to attend a performance/training clinic. Most international movements occurred in June, in which there were 12 movements to attend 2 competitions. These movements were made by 4 horses owned by 1 participant; 2 horses each attended 1 competition, and 2 horses attended both competitions. Of the movements to different provinces, 87% (13/15) were to attend competitions, and 13% (2/15) were to attend performance/training clinics.

Discussion

This study provides an overview of the descriptive characteristics and movement patterns of a sample of horses in Ontario. This study also provides insight into the characteristics of a sample of home facilities in Ontario, including the variable distribution of primary sport/competition disciplines within each facility. The findings in this study contribute to a better understanding of the demographics of a sample of horses in Ontario, in addition to the frequency and reasons for traveling on/off their home facilities. To the authors' knowledge, this study provides the first characterization of long-term horse movement patterns in Ontario.

Ninety-seven percent of horse movements throughout the study were bidirectional, where horses returned to their original

home facility after visiting a location elsewhere. In contrast to other livestock animals, the local movement of horses is often temporary (1,14). Given the bidirectional nature of most horse movements, it may be beneficial to implement infection prevention strategies for short-term movements on/off a facility. Ensuring that horse owners implement basic biosecurity practices, such as horse health monitoring, cleaning and disinfection of equipment/facilities, and having an individualized vaccination plan can reduce the risk of introduction and spread of disease (19).

Most participants (76.1%) reported that the horses boarded at their home facilities included a mixture of horses from primary sport/competition disciplines. This finding was different from those reported based on a survey of equine facilities in New Zealand, where 57.1% of facilities kept horses for a single purpose (7). This finding suggests that connections between different disciplines in the population may be facilitated through co-boarding of horses at home facilities. Connectivity between disciplines might increase the opportunities for spread of disease should a pathogen be introduced into horses of a single discipline (14).

In this study, horses that participated in competition and leisure disciplines had high vaccine coverage levels for the recommended "core" vaccines, which include vaccines for rabies, tetanus, and West Nile virus (20). In addition, reported vaccine coverage levels were higher in horses that participated in competition and leisure disciplines compared to horses that participated in racing. It is important to note that vaccination of horses in Ontario is voluntary, and therefore vaccination is not mandatory for horses to participate in shows or compete in racing events (20). Although the extent of vaccine coverage for equine respiratory diseases such as equine influenza and equine herpesvirus has been previously reported during outbreaks in Ontario (21,22), the current study describes the vaccine profile of a sample of Ontario horses in a non-outbreak context.

Online questionnaires have been used to describe horse characteristics and horse movement patterns in other equine populations (11,15). According to an industry-led study of Canadian horse owners in 2010, 89.2% of owners used the Internet, and 15.9% of those who did not use the Internet at that time expected to become users by 2011 (23). This suggests that a similar or higher proportion of horse owners would be Internet-users in 2015, and therefore the use of an online questionnaire likely did not explicitly exclude potential participants. The use of the monthly questionnaire attempted to decrease inaccurate recall, as it was thought that participants would be more likely to accurately remember their travel patterns within a short time frame. Participants may experience inaccurate recall if they travelled often with their horse, and had difficulty recalling which trips occurred on which date(s). Issues with recall may therefore affect the accuracy of the timeline of movements if the participant responded with the incorrect movement pattern, or if the participant did not provide a response at all. Nevertheless, the approach used in this study provides a more detailed and timely collection of long-term horse movement patterns compared to previous questionnaire-based approaches (8,9,14,15).

Due to the use of convenience sampling in this study, the potential impacts of selection bias should be considered. Participants could have had an increased likelihood of joining the study due to their personal perceptions or interests (e.g., travelling often increases a horse's risk for disease exposure), and therefore the sample of horse owners included in this study may have different travel patterns compared to the general horse owner in Ontario. Furthermore, it should be noted that horses in the racing industry were underrepresented in this study, and those that did participate were lost to follow-up after 2 mo (no responses were received for race horses between July and November 2015). Due to the underrepresentation of race horses herein, further research is warranted to examine the demographics and movement patterns of horses in the racing industry. Lastly, as horse movement patterns were only collected from May to November, the resulting movements should not be extrapolated over an entire year, as there may be important differences in the frequency of equestrian activities that occur during the winter, compared to summer and fall.

This study provides the first comprehensive description of a subset of horses in Ontario, following the industry-led study of Canadian horse owners in 2010 (22). While this study may not be representative of the entire horse population in Ontario, it provides insight into the descriptive characteristics of a subset of horses and horse facilities in Ontario, in addition to a refined understanding of their movement patterns. Furthermore, this study provides estimates of the vaccine coverage for various equine pathogens in this sample of horses. The detailed movement data collected in this study provide several opportunities for future research, including the use of spatial and network analyses to identify patterns in horse movements throughout the study period. The results of this study can inform further exploration of the potential for disease introduction and spread within the Ontario equine population.

Acknowledgments

The authors gratefully acknowledge the horse owners who participated in this study, and Karen Richardson for assisting in data entry. This work was supported by the OMAFRA-U of G Research Partnership, Equine Guelph, and the Canada Research Chairs program. Graduate student funding for KS was provided by an Ontario Graduate Scholarship and an Ontario Veterinary College Scholarship. CVJ

References

1. Robin CA, Wylie CE, Wood JLN, Newton JR. Making use of equine population demography for disease control purposes: Preliminary observations on the difficulties of counting and locating horses in Great Britain. Equine Vet J 2011 May;43:372–375.
2. Sánchez-Matamoros A, Martínez-López B, Sánchez-Vizcaíno F, Sánchez-Vizcaíno JM. Social network analysis of Equidae movements and its application to risk-based surveillance and to control of spread of potential Equidae diseases. Transbound Emerg Dis 2013;60: 448–459.
3. Firestone SM, Ward MP, Christley RM, Dhand NK. The importance of location in contact networks: Describing early epidemic spread using spatial social network analysis. Prev Vet Med 2011;102: 185–195.
4. Traub-Dargatz JL, Pelzel-Mccluskey AM, Creekmore LH, et al. Case-control study of a multistate equine herpesvirus myeloencephalopathy outbreak. J Vet Intern Med 2013;27:339–346.

5. Dominguez M, Munstermann S, de Guindos I, Timoney P. Equine disease events resulting from international horse movements: Systematic review and lessons learned. Equine Vet J 2016;48:641–653.
6. Guthrie AJ, Stevens KB, Bosman PP. The circumstances surrounding the outbreak and spread of equine influenza in South Africa. Rev Sci Tech Int Des Epizoot 1999;18:179–185.
7. Rosanowski SM, Cogger N, Rogers CW, Benschop J, Stevenson MA. A description of the demographic characteristics of the New Zealand non-commercial horse population with data collected using a generalised random-tessellation stratified sampling design. Prev Vet Med 2012; 107:242–252.
8. Rosanowski SM, Cogger N, Rogers CW, Bolwell CF, Benschop J, Stevenson MA. Analysis of horse movements from non-commercial horse properties in New Zealand. N Z Vet J 2013;61:245–253.
9. Boden LA, Parkin TDH, Yates J, Mellor D, Kao RR. Summary of current knowledge of the size and spatial distribution of the horse population within Great Britain. BMC Vet Res 2012 Apr 4;8:43. doi: 10.1186/1746-6148-8-43.
10. Wylie CE, Ireland JL, Collins SN, Verheyen KLP, Newton JR. Demographics and management practices of horses and ponies in Great Britain: A cross-sectional study. Res Vet Sci 2013;95:410–417.
11. Boden LA, Parkin TDH, Yates J, Mellor D, Kao RR. An online survey of horse-owners in Great Britain. BMC Vet Res 2013 Sep 28;9:188. doi: 10.1186/1746-6148-9-188.
12. Bell IG, Drury-Klein C. Analysis of horse movements and events during the 2007 outbreak of equine influenza in New South Wales, Australia. Aust Vet J;89 Suppl 1:63–68.
13. Christley RM, French NP. Small-world topology of UK racing: The potential for rapid spread of infectious agents. Equine Vet J 2003;35:586–589.
14. Hayama Y, Kobayashi S, Nishida T, Nishiguchi A, Tsutsui T. Risk of equine infectious disease transmission by non-race horse movements in Japan. J Vet Med Sci 2010;72:839–844.
15. Liebenberg D, Piketh S, van Hamburg H. A web-based survey of horse owners' perceptions and network analysis of horse movements relating to African horse sickness distribution in Namibia and South Africa. Acta Trop 2016;158:201–207.
16. Moloney BJ. Overview of the epidemiology of equine influenza in the Australian outbreak. Aust Vet J 2011;89:50–56.
17. Statistics Canada. Census of Agriculture, farms classified by the North American Industry Classification System (NAICS), every 5 years. 2016. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0040200&&pattern=&stByVal=1&p1=1&p2=31&tabMode=dataTable&csid= Last accessed May 15, 2018.
18. Spence KL, O'Sullivan TL, Poljak Z, Greer AL. Descriptive and network analysis of the equine contact network at an equestrian show in Ontario, Canada and implications for disease spread. BMC Vet Res 2017;21;13:191. doi: 10.1186/s12917-017-1103-7.
19. Canadian Food Inspection Agency. National farm and facility level biosecurity standard for the equine sector. 2016. Available from: http://www.inspection.gc.ca/animals/terrestrial-animals/biosecurity/standards-and-principles/equine-sector/eng/1460662612042/1460662650577 Last accessed May 15, 2018.
20. Wright B, Kenney D. Guidelines for the vaccination of horses [Internet]. 2004. Available from: http://www.omafra.gov.on.ca/english/livestock/horses/facts/info_vaccine.htm Last accessed May 15, 2018.
21. Carman S, Rosendal S, Huber L, et al. Infectious agents in acute respiratory disease in horses in Ontario. J Vet Diagnostic Investig 1997; 9:17–23.
22. Diaz-Mendez A, Viel L, Hewson J, et al. Surveillance of equine respiratory viruses in Ontario. Can J Vet Res 2010;74:271–278.
23. Equine Canada. Canadian Horse Industry Profile Study. 2010. Available from https://www.equestrian.ca/cfs/files/resources/GzFy3gdYuDdg58MY4/IN_2011_cnd_horse_study_report_cover-e.pdf?token=eyJhdXRoVG9rZW4iOiIifQ%3D%3D last accessed May 15, 2018.

Book Review
Compte rendu de livre

Self-Assessment Color Review, Veterinary Cytology: Dog, Cat, Horse, and Cow, 2nd edition

Cian F, Freeman K. CRC Press, Taylor & Francis Group. Boca Raton, Florida, USA. 2017. 219 pp. ISBN: 9781-4987-6671-5.

One of several in the Self-Assessment Color Review series, *Veterinary Cytology* offers a wide array of cytology cases to study. Although not exhaustive, it does offer a representative series of diagnostic scenarios for various species. Updated from the 1st edition 10 years previous, the 2nd edition continues to focus on teaching cytology with a practical and clinical approach. Clinical cases lend a more "real life" interpretation and discussion of the cytology slides provided. This leads to a richer self-study experience, but would not, however, make it a very useful reference resource. But then the text does not profess to be one.

It is important to be rigorous in ones description of cells and features noted and to become familiar with what "normal" looks like. Only then can a useful interpretation be made, offering significance, differential diagnoses, or prognoses. Each case is explored with several questions, forcing this routine approach in every case, eventually making it habitual. Questions with answers only found in the back of the text also allow the student to ponder the case free of the temptation to peak at the answer too soon. There are cases involving cats, dogs, cows, and horses; however, there is only a systems organization to these cases, and jumping from cat to horse back to dog can become a bit confusing. It might also be frustrating if the reader only wanted to study the cytology concerns of a single species.

Overall, this text can be quite useful in self-study. The interpretive guidance offered is excellent and thorough, making *Veterinary Cytology* worth purchasing.

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